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Zuzana KOLMANOVÁ, Martin MELIŠÍK[1]

THE ECONOMICAL AND QUALITY ASPECTS OF CUTTING MATERIALS BY WATER JET

EKONOMICKÉ A KVALITATÍVNE ASPEKTY DELANIA MATERIÁLOV VODNÝM LÚČOM

[1] ***Faculty of industrial technologies; Púchov, Slovakia,***

Abstract

The contribution deals with study of the quality of the machined surface cut by water jet performed on the basis of the cutting process observation, direct measurements associated with the analysis of the created cut surfaces and work pieces as the compact unit. In the main it draws benefits of this material cutting technology.

Abstrakt

Príspevok sa zaoberá štúdiom kvality obrobených povrchov delených vodným lúčom, realizovaného na základe pozorovania procesu delenia, priamych meraní spojených s analýzou novovzniknutých delených plôch a obrobkov ako celku v konkrétnych podnikových podmienkach. Vykresluje najmä výhody delenia materiálov touto metódou.

Key words: water jet, quality

1. Introduction

Dividing materials often present first operation in process of making element, at the end of which is completed article. Every technological operation, from first to last, manipulate in change of attribute whether cut surface or arrangement materials as aggregate and leave at the same time specific characters, which constitute actual condition surface work. Next to standard technology of machining, which respond to claim machining new materials for example by the new cutting materials(cut ceramics, pottery), they are helping in resolution problem hardmachining materials and new technologies as well, specified as progressive, unconventional among which belong to also cutting by water jet. Productional facilities technology of cutting by water jet and all above consequences duty in form quality finished made work create filling of refer work. Contribution was realized in concretely work conditions of company.

2. Dividing – water jet

Technological process use narrow high-pressure and high-speed drift of water (pressure of water ≈ 380 MPa) as cutting implement. To add fine abrasive, let us say compact elements, gain effect cutting, what expand ability of utilization water jet.

Cutting by water jet consist in strip material of mechanical effect impact narrow water drift with high-speed and kinetic energy on force area. Abrasive as an admixture, multiply mechanical effects impact. Jet as a drift of water is made by high-pressure of water, which coming through the gap of die with diameter~0,3mm. Jet of water filter going into the work, gradually loosing his kinetic energy and deviate.

In term of apply business data differentiate two main methods of cutting:

- WJM – machining by clean Water Jet
- AWJM – machining by abrasive Water Jet (Water jet with admixture fine elements – abrasive)

Te different between clean water jet and abrasive water jet is in insertion fine abrasive into drift of water.

Cutting by water jet and abrasive water jet is defined as high-erosion process, or as directed process erosion attrition, where abrasive cutting data is regulate into the jet with high-gash effect.

3. Arangement for water jet

The main components are hydraulic elements, multiplier, accumulator, water filters, pipe for cross-connecting frame of water, double – wave tap, die (water and abrasive), and container for absorption used composition: water, abrasive and elements of cutting materials. Hydraulic element, which is "heart" of technology attend for deduce high-pressure water jet.

High-pressure water jet is generating in majority case as a hydraulic arrangement, so called, multiplier. Commission of his system of pressure arrangement is smoothness creating surfaced fluid with constant pressure.

4. Measuring criteria

Gruffness of surface

The gruffness of surface is main coefficient of quality surface, which we take a measure according to design, aspect, and deepness foil, which will stay in surface of element after implement by machining. The gruffness of surface is given by foil-dimension very small irregularity of surface, which leave implement on the machining surface. It is specified as a micro geometric irregularity. Express amount of gruffness apply is usually describe by most characteristics, which is Medium arithmetic balance profile Ra.

Errors of the cutting

The errors at the edge of cutting and errors at the area, summarily specified as – errors irregularity or balance from specified design and position off cutting, I was following out at the place of work for a long time and characteristics of surface we were carrying out into effect based on visual notice.

Into notice of cutting surface we were carrying out straight measurement as well, focus to balance of angle jet (balance uprightness). The balance of angle jet we allocated positive and negative attributes, according to measurement balance from named design. Together with measuring data balance of angle cut, we have mentioned calculate dimension balance of work involve evenly inducted of angle cut balance.

Surface defects

Surface defect-is defined as a geometric component, imperfection or batch of geometric component and imperfection of real surface, which has arise without purpose or accidentally during making.

Appearance of surface defects (also as errors at the edge and cut area), we were carrying out at each work place for a long time and the characteristics of surface we were carrying out at the base of visual notice.

Analyse of gruffness, balance of angle cut (balance of uprightness) and width of cut has been realized at materials: steel 11 523, steel 17 246, duraluminium 42 4415, by their same thickness=4mm.

Induct common width ness materials has been choose because, that measurement can not be affect by different kind of thickness cutting materials. All other measurement and notice focuses on study of quality divided surfaces, so error defects has been realized at the same kind of materials, that is steel 11 523, steel 17 246, duraluminium 42 4415, but by different thickness. Analyse width

allowance thickness We have choose after consultation with technologist, which they had advertise me a fact, that many errors will display and rise when by cutting by bigger thickness of material.

Valorisation consequences resolution

Resolution consequences are possible to sum up into two forms:

- technical valorisation
- economical valorisation

Technical valorisation

From panel 1 is resulting, that the best gruffness was attached by cutting materials 17 246, the worst was by cutting duraluminium. This fact is apparently connected with chemical-physical attribute dividing materials, especially their mechanical amount.

When the material stronger and harder is the gruffness dividing surfaces by water jet is better.

The biggest balance uprightness was measured at material 17 246, almost the same amount was measured at duraluminium, however at material 11 523 is the lowest balance uprightness. This fact is connected with resistance, which material is putting to cutting implement, in this case water jet.

Economical valorisation

From economical valorisation is possible to make following valorisation cutting materials by water jet. Water jet is applicable in large sentiment materials, what does not allow any other technology. We apply dividing into following materials: all kind of steel, implements, hardened steel, spring steel, copper and her alloy, bronze, brass, aluminium and his alloy, for example: duraluminium, plastic, including stratified, titanium and other alloys...

Is possible to state, that this technology is prospective to change all series sole cutting equipments for the one equipment only, which is water jet. Economical effectiveness is in following categories:

- If we think, that equipment water jet can cut a large range of goods, we have to think with minimum of 3 cutting equipments, if it would not exist this technology. For a think of 3 alternate technologies in equipment water jet is necessary to think with 3 work areas. So if equipment of water jet has necessary approximately 10m2 (production and utility area) by 3 sole equipments I think of necessary 30m2. Saving of working area is 20m2.
- Equipment water jet is operate by 1 worker, thought alternate 3 types of technology equipments are request 3 working places. If we think, that average wage of worker is 600€ per month, it is saving 1200€ per month.
- Cold cut, which water jet provide is clear, is not need to be modified this cut, as it is in case of other technologies(laser, plasma). In this way are not rising any other charges for reform of the cut.
- Clear cut is not need to be modified by other operations, for example, reform by rasper, flopping off or by abrasive disc as it is with dividing by plasma or laser, where in hourly production of goods is modify divided surface in time relation approximately 10 minutes, what is by 8 hours working shift 80 minutes and by hour wage it is saving 0,5€ per hour, which is 4,54€ per 8 hours working shift and per month (where I think 22 working days) is saving 100€ per month.
- Cold cut is also more safe in term of storage and manipulation with material, where is not need to be threaten danger by scorch accident.

- In term of storage and manipulation cold cut provide trouble free manipulation, which is economical displayed in saving of safety instrument. There is not need so many safety instruments as by any other Technologies as is cutting by plasma or laser.
- If worker use 2 pairs of safety gloves by equipment water jet per month, worker of another equipments (cutting by plasma) use 8 pairs of safety gloves, because of cutting by plasma jet consist in melting cutting material ultra high temperature (>10000°C). If we think about the price of 1 pair safety gloves 3€, then it is saving 18€ per month, only for safety gloves. Of course, that here is necessary many others working and safety instruments and working dresses and shoes. Clear cut and narrow zone of cut does not make scobs, so it does not load working place by waste and his liquidation.
- Cutting area dividing by water jet does not make scobs, what is compared with saw – disc forms for economical effect in saving charges invest for manipulation with waste and his liquidation.
- If company at cutting by saw-disc produce per month 0,5 ton of waste, they must pay to specialists company for his liquidation and clearance per 1 kg 1€. It is by this production of waste 500€ monthly. This quantity of waste must be regularly stock in litterbin, what is making secondarily requirements at areas (rental for warehouse) and charges for reservation of collecting bin. If we think about stock for waste, which is approximately 10m2, then it is by rental space for 11 €/m2 per month is saving charges 110€.
- Equipment water jet is possible to make curve cutts, what means, that incoming material is possible to use maximum economical. Technology waste is minimal.
- Disadvantage of this is high purchased cost and specific reserve place from working place, where equipment for the setting up is and supply of power water.

By comparison technologies of cutting by water jet and cutting materials by other technologies we have find out, that dividing materials by water jet is coming up certain saving charges, which is 2145€ per month in the conditions of given company. Of course according to that nobody told me the information about operating costs, about purchased cost of equipment, about rental charges or other charges with operation service of this equipment, this we can state only.

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Reviewer: Ing. Josef Foldyna, CSc., ÚGN AV ČR Ostrava